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THE DISTRIBUTION OF WOOD-BORING
LIMNORIA IN CALIFORNIA¹

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INTRODUCTION

The distribution of marine wood-boring species of *Limnoria* along the California coast presents an interesting pattern. Three species are known. Some ecologic data are available on factors which appear to govern the distribution of the species in San Francisco Bay and the Los Angeles-Long Beach harbors. These data are summarized here.

Northward of Crescent City only one species, *Limnoria* (*Limnoria*) *lignorum* (Rathke), is known. Similarly southward of La Jolla only *L. (L.) tripunctata* Menzies has been found. Between Crescent City and La Jolla *L. (L.) quadripunctata* Holthuis is found either alone or with the species impinging upon its northern or southern limits. Here it is not uncommon to collect two species from one piece of infested wood. However, *L. (L.) quadripunctata* Holthuis was the only species found at Tomales Bay, Morro Bay, and Santa Barbara (Menzies and Mohr, 1951).

The characteristic pleotelsons of these three species are shown in figure 1.

SAN FRANCISCO BAY AND TRIBUTARIES

The ecological relations of the marine wood-boring organisms in San Francisco Bay were investigated in 1924 by Miller (1926, pp. 247-254)

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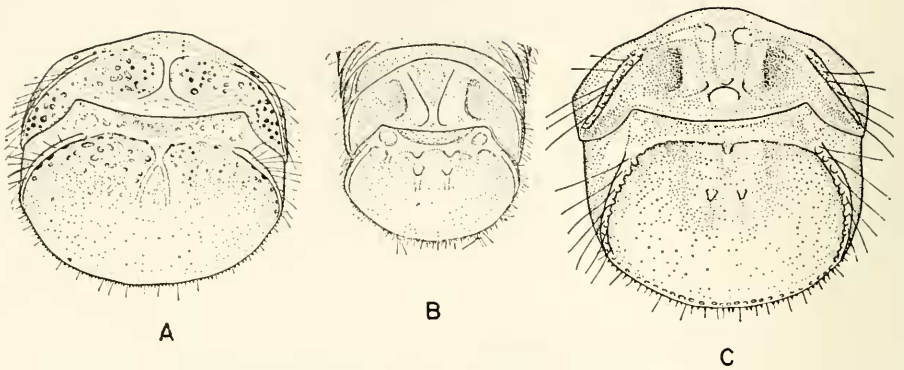


Figure 1. Pleotelsons of California limnorias. A, *Limnoria (L.) lignorum* (Rathke); B, *L. (L.) quadripunctata* Holthuis; C, *L. (L.) tripunctata* Menzies (after Menzies, 1957).

and his associates. This information was included in a later report by Kofoid and Miller (1927). Regarding *Limnoria* the latter investigators write, "the characters of the organism occurring in San Francisco Bay correspond closely to those of *L. lignorum* and it should undoubtedly be included in that species" (*ibid.*, p. 311-312). However, the species shown in figure 124 of that report, as Holthuis (1949) and Menzies and Mohr (1952) point out, probably is *L. (L.) quadripunctata* Holthuis. A reinvestigation of the bay by the writer² showed the presence of two species, *L. (L.) quadripunctata* and *L. (L.) tripunctata*. No specimens of *L. (L.) lignorum* were found, and in view of the preference for cold water exhibited by this species (Menzies, 1957), it is doubtful whether it has occurred in San Francisco Bay during historical times. The identity of *Limnoria* in San Francisco Bay assumes particular significance in view of the argument by Kofoid and Miller (*op. cit.*) that the *Teredo* occurring there probably belongs to the European *T. navalis* because (in part) the *Limnoria* present is *L. lignorum*. The argument loses much of its force in view of the finding that *L. lignorum* probably was not there.

This distribution of the species of *Limnoria* in San Francisco Bay is shown in figure 2. In table I are shown the stations examined, species found, and the salinity and temperatures occurring at the stations for which such data were available.

Miller (1926, pp. 247-248) correctly pointed out that the variable and low salinity of the northern and northeastern parts of the bay came within the salinity level lethal for *Limnoria* and records the uppermost limit of destruction by this borer to be about three miles above Point San Pedro (Loc. no. 1, table I). Throughout most of the margin of the bay from

² Assisted by a grant-in-aid from the American Academy of Arts and Sciences, Boston, Massachusetts.

Black Point to San Pedro and from Black Point to Vallejo and Mare Island, there is very little wood. The same is true for the greater part of the bay south of South San Francisco and Oakland. Of the twenty-three stations examined, only three were negative, Stations 21, 22, 23. At these stations the salinity is very low and variable seasonally (15 o/oo, 13 o/oo-29 o/oo) and it appears that low salinity at these stations accounts for the absence of *Limnoria*.

At Rodeo (Sta. 20) *L. (L.) tripunctata* was found in hollowed-out, water-filled cavities in a creosoted telegraph pole. It was not found on wooden structures which were in constant direct contact with the sea water, such as teredo-riddled sewer easings which extended a considerable distance into the bay at that point. That such a pocket of *Limnoria* might act as a focal point for the spread of the animal during dry seasons seems evident.

Table I. List of stations occupied in a resurvey of San Francisco Bay (1949)*

Station Number	Location	Temperature °C	Salinity o/oo	Species of <i>Limnoria</i> (<i>Limnoria</i>)
1	Point San Pedro	—	—	<i>L. tripunctata</i>
2	San Rafael (U.S. Highway 101)	—	—	<i>L. tripunctata</i>
3	San Quentin	—	—	<i>L. tripunctata</i>
4	Point San Quentin	—	—	<i>L. tripunctata</i>
5	Tiburon	—	—	<i>L. tripunctata</i> <i>L. quadripunctata</i>
6	N. W. Pac. R. R. Ferry	12.2	30.85	<i>L. quadripunctata</i>
7	Sausalito	13.2	30.30	<i>L. quadripunctata</i>
8	Aquatic Park	14.2	30.50	<i>L. quadripunctata</i>
9	Goat Island	15.3	28.80	<i>L. quadripunctata</i>
10	India Basin	—	—	<i>L. quadripunctata</i>
11	South Basin	—	—	<i>L. tripunctata</i>
12	San Mateo Bridge	—	—	<i>L. tripunctata</i>
13	West end of Dumbarton Bridge.....	—	—	<i>L. tripunctata</i>
14	East end of Dumbarton Bridge.....	20.6	28.10	<i>L. tripunctata</i>
15	Oakland	18.0	27.00	<i>L. tripunctata</i>
16	Berkeley Yacht Harbor	—	—	<i>L. quadripunctata</i> <i>L. tripunctata</i>
17	Parr-Richmond Pier	—	—	<i>L. quadripunctata</i> <i>L. tripunctata</i>
18	Richmond Ferry Landing	—	—	<i>L. quadripunctata</i> <i>L. tripunctata</i>
19	Oleum	—	—	<i>L. tripunctata</i>
20	Rodeo (see text)	—	—	<i>L. tripunctata</i>
21	Crockett	19.2	15.00	none
22	Vallejo	—	13.29	none
23	Black Point	—	—	none

* Temperature and salinity data from Kofoid and Miller (1927), Sumner *et al.* (1914).

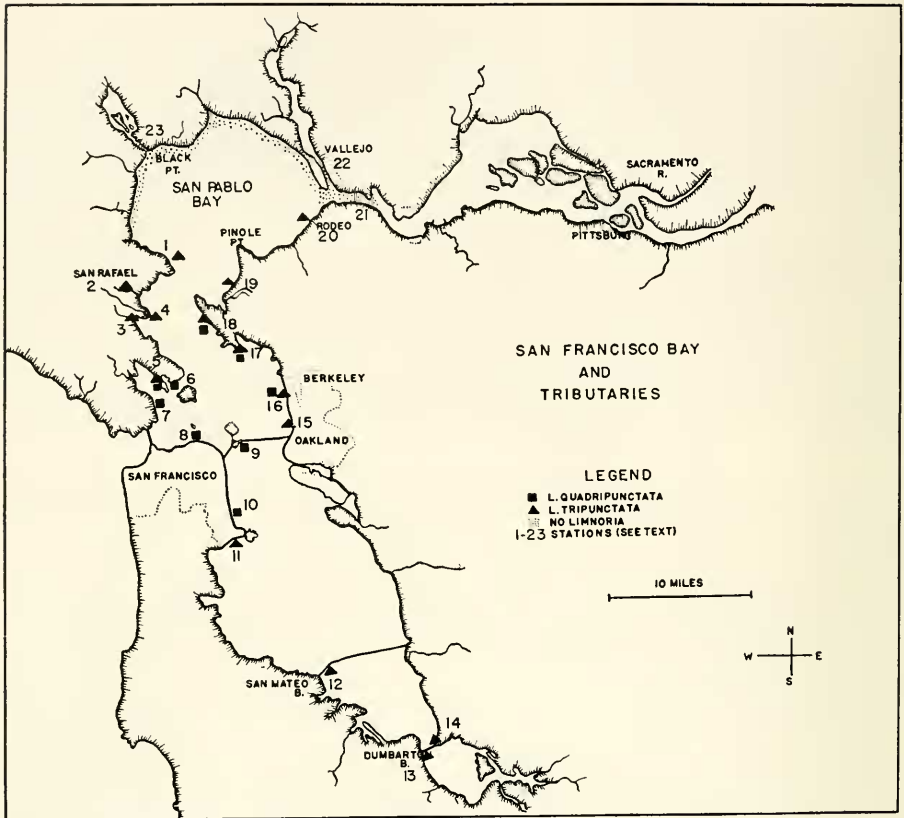


Figure 2. The distribution of *Limnoria* within San Francisco Bay and its tributaries.

Miller did not suspect that temperature might act as a factor controlling distribution of *Limnoria* within the bay. He was, however, aware of the very different temperature conditions in certain areas. The resurvey revealed a striking distribution associated with temperature distribution. The outermost colder regions of the bay, Stations 6–10, contained only *L. (L.) quadripunctata*. The inner and much warmer areas (Stas. 1–4, 11–15) of the bay also showed only one, *L. (L.) tripunctata*. At intermediate stations (Stas. 5, 16, 17, 18) specimens of both species were taken from the same piece of wood.

LOS ANGELES—LONG BEACH HARBORS

The Los Angeles—Long Beach harbors (figure 3) present some conditions which parallel those in San Francisco Bay and others which differ

considerably. At both places, the species found were the same. The local variations in temperature correlated with the general distribution of the two species with *L. (L.) quadripunctata* occupying the colder areas, *L. (L.) tripunctata* the warmer areas, and both being found together at intermediate locations. Salinity variations at Los Angeles–Long Beach harbors are exceptionally slight, being only 26.4 ‰–35.22 ‰ for the most variable location and, as might be expected, salinity variations were found to play no part in the distribution of the species. The dissolved oxygen content of certain parts of the harbor was very low and at the Consolidated slip where the average dissolved oxygen content was 0.12 (range 0.0–1.4) p.p.m. no specimens of *Limnoria* were found. However, at Berth 181 (inner harbor) where the highest dissolved oxygen content averaged 1.9 (range 0.0–4.0) p.p.m. and at the other stations where it was higher, *Limnoria* was found in test-blocks.

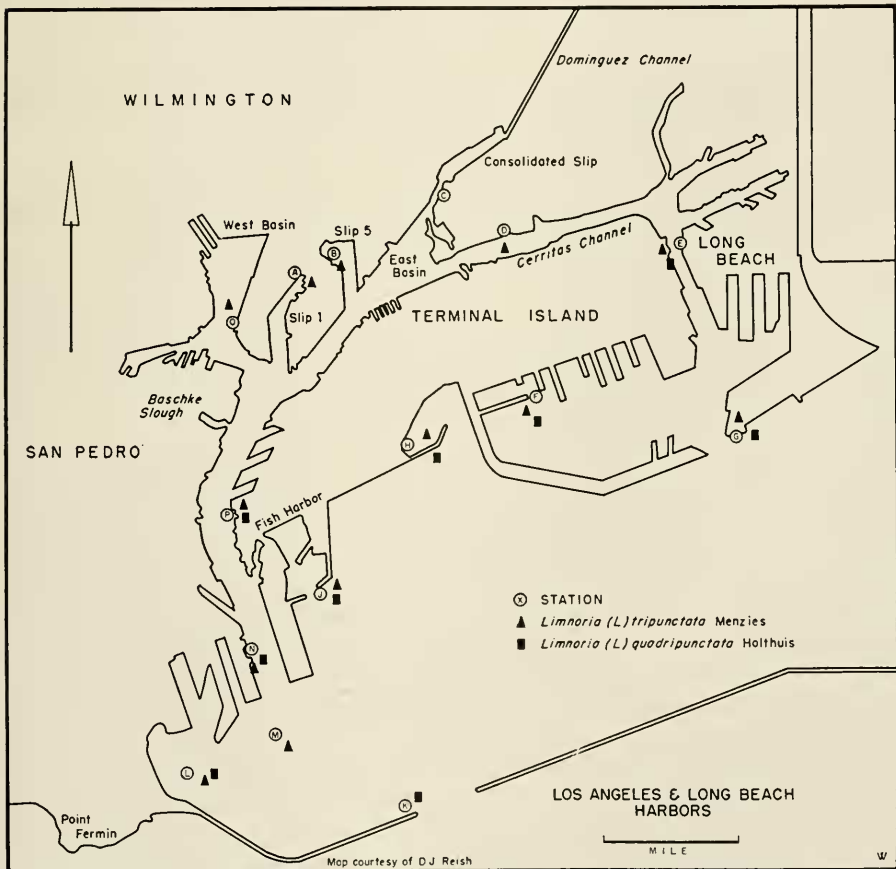


Figure 3. The distribution of *Limnoria* within the Los Angeles–Long Beach Harbor. Data and map courtesy of the Southern California Marine Borer Council.

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